SYSTEMS, METHODS, AND VALVES FOR PROVIDING PRESSURIZED WATER TO A PLURALITY OF WATER JETS IN A BATHING ENCLOSURE

FIELD OF THE INVENTION

[0001] This invention relates, generally, to systems and methods for providing pressurized water to water jets in a bathing enclosure, and, more particularly, systems and methods for regulating the flow of pressurized water to spas, pools or showers, by diverting at least some of the flow of pressurized water away from the water jets.

BACKGROUND AND SUMMARY OF THE INVENTION

[0002] Pools and spas are often provided with a plurality of inlets for introducing pressurized water for water circulation, display, or therapy, among other reasons. These water inlets, for example, water jets, are typically provided with a stream of pressurized water by means of a circulation pump. At least one manifold having a plurality of outlets may be provided between the circulation pump and the plurality of water jets to provide a plurality of streams of pressurized water to the plurality of water jets. Each outlet of the manifold is typically connected to an individual water jet. In such prior art systems, the circulation pump is typically a single-speed or two-speed (typically, high speed) fixed displacement pump providing a single flow rate and pressure (or static head) depending upon the piping, manifold, and water jets fed by the pump. Variable speed pumps are expensive, and are typically not used in conventional spa and pool applications because of the increased expense. Thus, with a single-speed pump, with relatively identical pressure drops across the piping, manifold, and water inlets, in a typical prior art system, an essentially equal amount of water is introduced to and discharged out of each water jet.

[0003] As often occurs in pools and spas, the user of the pool or spa may desire to vary the flow rate out of one or more of the water jets. In some prior art systems and methods, the flow of water out of one or more water jets may be varied by varying the size of the opening of one or more water jets, for example, by means of some form of

variable orificing in the one or more water jets. By restricting the size of the opening of one more water jets, the flow of water out of the one or more water jets may be decreased, as desired. However, in this typical prior art system, since the single-speed pump typically provides a fixed pressure and flow rate, the decrease in flow to the restricted water jets results in an increase in flow of water to the unrestricted jets. That is, according to the prior art, decreasing the flow to one or more inlets results in an increased flow to the other inlets.

[0004] Moreover, according to this typical prior art system, since the high speed pump provides a relatively fixed pressure and flow rate, the flow of water through a given set of water jets cannot be varied without introducing or removing one or more of the water jets. That is, the rate of flow out of a set of water jets cannot be varied without opening or closing one or more water jets. In addition, once all the available water jets have been opened, the bather may increase the rate of flow of water out of the set of water jets, but the bather cannot decrease the rate of flow of water out of the set of water jets . The flow out of the water jets is set by the pressure and flow provided by the single-speed or two-speed pump.

[0005] The present invention overcomes these limitations of the prior art by providing means to regulate the flow of water out of one or more water jets without varying, for example, increasing, the rate of flow out of the unregulated water jets. Aspects of the present invention provide the bather with a more enjoyable bathing experience by, among other things, allowing the bather to better control the flow of water out of individual water jets.

SUMMARY OF THE INVENTION

[0006] One aspect of the invention is a system for providing pressurized water to a set of water inlets in a bathing enclosure, the system including: at least one source of pressurized water; at least one manifold having at least one inlet in fluid communication with the at least one source of pressurized water and a plurality of outlets in fluid communication with the set of water inlets; and a user-operable diverter configured to

divert at least some of the pressurized water away from the manifold and to the bathing enclosure. In one aspect of the invention, the user-operable diverter is positioned upstream of the manifold. In another aspect of the invention, the user-operable diverter comprises a variable user-operable diverter.

[0007] Another aspect of the invention is a system for providing pressurized water to a set of water inlets in a bathing enclosure, the system including: at least one source of pressurized water; at least one manifold having at least one inlet in fluid communication with the at least one source of pressurized water and a plurality of outlets in fluid communication with the set of water inlets; and a user-operable diverter configured to divert at least some of the pressurized water away from the set of water inlets and to the bathing enclosure.

[0008] A further aspect of the invention is a method for providing pressurized water to a set of water inlets in a bathing enclosure, the method including: providing at least one source of pressurized water; providing at least one manifold having an inlet in fluid communication with the at least one source of pressurized water and a plurality of outlets; distributing the pressurized water from the plurality of outlets of the at least one manifold to the set of water inlets; and diverting at least some of the pressurized water away from the set of water inlets and to the bathing enclosure.

[0009] A further aspect of the invention is a method for providing pressurized water to a set of water inlets in a bathing enclosure, the method including: providing pressurized water to a manifold, the manifold being in fluid communication with a first set of water inlets in a bathing enclosure; and manually diverting at least some of the pressurized water away from the first set of water inlets to one or more second water inlets in the bathing enclosure, wherein the pressure drop across the one or more second water inlets is less than the pressure drop across the first set of water inlets.

[0010] Another aspect of the invention is a system for providing pressurized water jets to a bathing enclosure, the system including: at least one single speed pump for providing a source of pressurized water; at least one manifold having at least one inlet

and a plurality of outlets, the at least one inlet in fluid communication with the at least one single speed pump; a set of water jets adapted for introducing the pressurized water to the bathing enclosure, the set of water jets in fluid communication with the plurality of outlets of the at least one manifold; and a variable diverter configured to divert at least some of the pressurized water away from the set of water jets and to the bathing enclosure.

[0011] A still further aspect of the invention is a pressure relief valve for a bathing enclosure, the pressure relief valve including: a cylindrical housing having an open first end comprising an outlet and a second end opposite the open first end; an inlet positioned between the outlet and the second end of the cylindrical housing, the inlet providing water having a pressure; a barrier positioned in the cylindrical housing to substantially hydraulically isolate the inlet from the second end of the cylindrical housing; an orifice assembly mounted in the cylindrical housing between the barrier and the outlet, the orifice assembly including: a hollow valve body mounted in the open first end of the cylindrical housing, the hollow valve body having a closed first end having an orifice and an open second end; and an orifice cover mounted over the orifice of the valve body, the orifice cover mounted to resist deflection relative to the valve body in response to the pressure of the water; and means for varying the resistance to deflection of the orifice cover in response to the pressure of the water wherein the flow of water from the inlet to the outlet is varied. In one aspect of this invention, the pressure relief valve further comprises a valve actuator mounted in the second end of the cylindrical housing, and wherein the means for varying the resistance of the deflection of the orifice cover is controlled by the valve actuator. In another aspect of this invention, the orifice cover is mounted on a first rod and the first rod is operatively connected to the valve actuator.

[0012] Thus, aspects of the present invention provide improved systems, methods, and valves for regulating the flow of pressurized water to a plurality of water jets in a bathing enclosure. Aspects of the present invention overcome limitations of the prior art by, among other things, allowing the bather to regulate the flow of pressurized water out

of one or more water jets without affecting the flow of water out of other water jets. The present invention may control the flow of water jets anywhere in a bathing enclosure, for example, to one or more seats in a spa. Details and advantages of aspects of the present invention will become more apparent upon review of the attached drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0013] The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other objects, features, and advantages of the invention will be readily understood from the following detailed description of aspects of the invention taken in conjunction with the accompanying drawings in which:

[0014] FIGURE 1 is a schematic diagram of a typical prior art system for providing a plurality of streams of pressurized water to a plurality of water jets mounted in a bathing enclosure.

[0015] FIGURE 2 is a schematic diagram like FIGURE 1 illustrating one aspect of the present invention that is an improvement of the prior art system shown in FIGURE 1.

[0016] FIGURE 3 is a cross-sectional view of a valve assembly according to one aspect of the present invention.

[0017] FIGURE 4 is an exploded perspective view of the valve assembly shown in FIGURE 3 according to one aspect of the invention.

DETAILED DESCRIPTION OF FIGURES

[0018] The details and scope of the aspects of the present invention can best be understood upon review of the attached figures and their following descriptions. FIGURE 1 illustrates schematic diagram of a typical prior art system 10 over which the present invention is an improvement. A typical prior art system of FIGURE 1 includes a bathing enclosure 12, for example, a spa or pool, having a water level 14 and supported by structure 15. Bathing enclosure 12 may typically have a plurality of pressurized water inlets, or water jets, 16 that provide a plurality of streams of water to bathing enclosure 12. In the prior art system 10 shown in FIGURE 1, bathing enclosure 12 includes a seat 18 having a seat back 20, in which the plurality of water jets 16 are located, and a foot well 22. Bathing enclosure 12 may also include a water outlet or drain 23 having a drain cover 25.

[0019] According to this prior art system 10, pressurized water is provided to water jets 16 via a plurality of conduits 24 and at least one manifold 26. Manifold 26 typically includes at least one inlet 28, operatively connected to a single-speed, fixed-displacement pump 30, and a plurality of outlets 29 which communicate with conduits 24. Pump 30 communicates with the at least one manifold inlet 28 via at least one conduit 31. As is typical, pump 30 is provided with a source of power via wire or cable 32 and a source of water via conduit 34.

[0020] According to this typical prior art system 10, a bather may vary the flow of water out of one or more water jets 16, for example, by varying the size of the orifice in a water jet 16 or by regulating a valve associated with water jets 16. However, according to this prior art system, where manifold 26 is fed by means of single-speed pump 30, varying the flow of water out of one or more water jets 16 will inherently vary the flow out of one or more other water jets 16. For example, since pump 30 typically provides water at a relatively constant pressure, restricting the flow of water out of one water jet 16 will increase the flow out of the remaining water jets 16. As a result, according to this prior art system, the flow of water out of one or more water jets 16 cannot be varied without varying the flow out of one or more other water jets. This

inherent limitation of the prior art system 10 can be inconvenient to the bather attempting to adjust the flow of water our of one or more water jets 16. Aspects of the present invention address this limitation.

[0021] FIGURE 2 is a schematic diagram similar to FIGURE 1 of a system 40 according to one aspect of the present invention. As in prior art system 10 shown in FIGURE 1, system 40 includes a bathing enclosure 42, for example, a spa or pool, having a water level 44 and supported by structure 45. Bathing enclosure 42 includes a plurality of pressurized water jets 46 that provide a plurality of streams of water to bathing enclosure 42. For example, according to one aspect of the invention, water jets 46 may comprise a Cyclone™, Storm™, or Power Stream™ water jet marketed by Saratoga Spa and Bath of Latham, NY, for example, as described in U.S. Patent 6,182,303 (the disclosure of which is incorporated by reference herein). According to aspects of the present invention, system 40 may include a plurality of water jets 46 located anywhere in bathing enclosure 42. For the sake of illustration of aspects of the present invention, bathing enclosure 42 includes at least one seat 48 having a seat back 50 and the plurality of water jets 46 located in seat back 50. According to one aspect of the present invention, bathing enclosure 42 may also include at least one foot well 52. Bathing enclosure 42 may also include a water outlet or drain 53 having a drain cover 55. Water outlet 53 may be located in foot well 52.

[0022] Similar to system 10 shown in FIGURE 1, according to aspects of the present invention, system 40 may include a manifold 56 and a source of pressurized water 60, for example, a pump. Manifold 56 includes at least one inlet 58 for receiving pressurized water and a plurality of outlets 59 which communicate with a plurality of conduits 54 which direct water to the plurality of water jets 46. According to one aspect of the invention, manifold 56 may comprise any structure or device having at least one inlet 58 and a plurality of outlets 59, for example, manifold 56 may comprise a simple pipe tee having a single inlet and two outlets. According to another aspect of the invention, manifold 56 comprises a variable port manifold, for example, a Roto Stream™ manifold valve marketed by Saratoga Spa and Bath Company and described in U.S.

Patents 6,185,757 and 6,490,740 (the disclosures of which are incorporated by reference herein). Pressurized water source 60 may comprise any type of source of pressurized water, for instance, water having a pressure of at least 5 psig, for example, between about 5 psig and about 25 psig. However, to facilitate discussion, in the following discussion pressurized water source 60 will be referred to as "a pump 60". Pump 60 communicates with one or more inlets 58 of manifold 56 via one or more conduits 61. Pump 60 is provided with a source of power via wire or cable 62 and a source of water via conduit 64.

[0023] Unlike prior art systems, such as system 10 in FIGURE 1, according to one aspect of the present invention, system 40 includes at least one water diverter device, or diverter, 70 for diverting water away from water jets 46. (Though the terms "valve" or "diverter valve" may be used throughout this specification, it will be understood that diverter device 70 and its related devices may comprise valves or any other type of device which can be used to divert the flow water from one path to another path.) For example, in one aspect of the invention, as shown in FIGURE 2, diverter valve 70 is located in conduit 61 between pump 60 and manifold 56, for example, upstream of manifold 56. According to one aspect of the invention, diverter valve 70 diverts pressurized water from pump 60 to bathing enclosure 42. According to the present invention, water may be diverted to anywhere in bathing enclosure 42, for example, to locations in enclosure 42 which would least impact the comfort or bathing experience of a bather, for instance, to a location in the bathing enclosure where the flow of diverted water does not impinge the body of the bather. In one aspect of the invention, water is diverted to foot well 52 via conduit 72, for example, via a water inlet 73.

[0024] In another aspect of the invention, the pressure drop of the flow of diverted water when introduced to enclosure 42 is markedly lower than the pressure drop of the water introduced to the enclosure via water jets 46. In conventional water jet design, the hydraulic pressure upstream of water jet 46 is typically greater than the hydraulic pressure present at the discharge of water jet 46. This difference in pressure across the inlet, or "the pressure drop" or "the delta P", accelerates the water whereby the desired

jet of water, typically, a turbulent jet of water, is produced, for example, for impinging the body of the bather. The pressure upstream of water jet 46, for example, the pressure in conduits 54 or manifold 56, may be at least about 3 psig, for example, at least about 3 to 5 psig. In one aspect of the invention, the pressure upstream of water jet 46 may be between about 5 psig and about 15 psig, and may typically be between about 8 psig and about 15 psig. The pressure downstream of water jets 46, for example, in enclosure 42, is typically only the static head of the water in enclosure 42 at the elevation of the water jet, for example, about 4 inches to about 24 inches of water, that is, about 0.14 psig to about 0.86 psig. Thus, in one aspect of the invention, the pressure drop across water jets 46 is typically about the same as the pressure upstream of water jets 46, for example, between about 5 and 15 psig. According to one aspect of the invention, the pressure drop of the flow of diverted water when introduced to enclosure 42, for example, via inlet 73, is markedly lower than the pressure drop of the water introduced to the enclosure via water jets 46, for example, lower than the pressure drop across each of the water jets 46. In one aspect of the invention, the introduction of the diverted flow to enclosure 42 is insignificant or unnoticeable to the bather in the enclosure. In one aspect of the invention, the pressure drop of the flow of diverted water when introduced to enclosure 42 is at least 50% less than the pressure drop of the water introduced to the enclosure via water jets 46. In one aspect of the invention, the pressure drop is at least 75% less, for example, at least 90% less. As a result, the flow of diverted water into enclosure 42 may not be accelerated whereby a turbulent jet of water is introduced to the enclosure. In one aspect of the invention, the diverted water in, for example, conduit 72, is introduced to enclosure 42 with little or no pressure drop, for example, with little or no turbulence. In one aspect of the invention, the pressure drop across inlet 73 is less than about 5 psi, for example, less than about 3 psi. According to one aspect of the invention, with the regulation of flow by means of, for example, valve 70, the pressure drops across inlets 46 and 73 are related and vary somewhat proportionally. For example, in one aspect of the invention, as the pressure drop across inlet 46 increases, the pressure drop across inlet 73 decreases, and vice versa.

[0025] In another aspect of the invention, shown in phantom in FIGURE 2, a diverter valve 75 may be located in one or more conduits 54, that is, between manifold 56 and one or more water jets 46. Diverter valve 75 may be used alone or with diverter valve 70. According to one aspect of the invention, diverter valve 75 may direct water from one or more conduits 54 to conduit 72 via a conduit 74 (shown in phantom), or to a separate conduit 76 (shown in phantom) to enclosure 42, for example, to foot well 52 via water inlet 77.

[0026] In another aspect of the invention (shown in phantom in FIGURE 2), a diverter valve 170 may be used to regulate the flow of water to one or more other locations within one or more enclosures 42, for example, to one or more other sets of water jets 46. In one aspect of the invention, the one or more other sets of water jets 46 may be located in one or more other seats similar to seat 48. According to this aspect of the invention, a conduit 161 communicates with the pressurized water in conduit 61, for example, by means of a pipe tee. Conduit 161, though truncated in FIGURE 2 for ease of illustration, directs water to one or more other locations in enclosure 42, for example, to one or more other manifolds 56. A diverter valve 170 (which may be similar to valves 70, 71, and 75) is positioned in conduit 161 and diverts water to enclosure 42, for example, to foot well 52, in a fashion consistent with other aspects of the invention. For example, valve 170 may direct water to a conduit 172 which directs water to enclosure 42, for example, via conduit 72, though other conduits may be used within the scope of the invention. According to this aspect of the invention, the flow of water to two or more locations within enclosure 42, for example, the flow of water to two or more seats 48 having water jets 46, may be regulated with little or no impact upon the flow of water to other locations in enclosure 42. For instance, using a single pump 60, a bather seated in a first seat 48 in enclosure 42, with enclosure 42 having at least one second seat similar to seat 48 having water jets 46, may regulate valve 170 and vary the flow of water to one or more water jets in the first seat with little or no effect upon the flow of water to the at least one second seat. According to aspects of the present invention, system 40 may include two or more diverter valves 170. Each of the two or more valves

170 may divert water to one or more locations, for example, to one or more seats, in one or more enclosures 42.

[0027] Diverter valves 70, 71, 75, and 170 may be positioned anywhere adjacent to or distal bathing enclosure 42. In one aspect of the invention, valves 70, 71, 75, or 170 is positioned adjacent enclosure 42 whereby an occupant of enclosure 42 can readily access valve valves 70, 71, 75, or 170. In one aspect of the invention, valve 71, 70, 75, or 170 may be mounted to the wall of enclosure 42, for example, in or adjacent to seat 48, or in or adjacent to foot well 52, for example, as shown in phantom by valve 71 in FIGURE 2. In one aspect of the invention, valve 70, 71, 75 or 170 is in fluid communication with the pressurized water provided by pump 60 to inlet 58 of manifold 56, for example, via conduit 72. In one aspect of the invention, without valve 70 present in conduit 61, for example, valve 71 may communicate with conduit 61 by means of conduit 72 and a conventional "tee" joint in conduit 61.

[0028] According to aspects of the present invention, the bathing experience may be enhanced and the size, power, and cost of the pumps used to supply water jets may be markedly reduced. For example, according to the prior art, a spa or hot tub having a plurality of seats - each seat having a plurality of water jets - may require a single 5 horsepower (Hp) pump to provide pressurized water to each of the water jets. Typically, the relatively high operating pressure and flow of such a pump discourages the user from varying the flow of water to any one set of water jets because the flow to other sets of water jets will also vary, sometimes markedly. For instance, if the flow of water to 3 of 4 seats in a spa is shut off, the flow of water to the remaining seat can increase dramatically. In extreme cases, the resulting water flow to the remaining seat can become uncomfortable to the bather. According to the present invention, this is avoided. For example, according to the present invention, the flow of water to 3 of 4 of the seats can be re-directed to, for example, the foot well, and the flow to the remaining seat may be unchanged.

[0029] In one aspect of the invention, one higher power pump may be replaced by a plurality of lower power pumps. For example, in a 4-seat spa, a single 5 Hp pump

which provides pressurized water to water jets in each of the seats, may be replaced by four lower Hp pumps, for example, four less expensive 1-Hp pumps. According to one aspect of the invention, the four 1-Hp pumps may have a plurality of diverters associated with them; for example, each pump may have a corresponding diverter. According to this aspect of the invention, each bather may regulate the flow of water to the water jets in the bather's seat without affecting the flow of water to the seats of the other bathers in the spa.

[0030] Diverter valves 70, 71, 75, and 170 may be any type of water diverting devices that are adapted to redirect the flow of water from one conduit to another conduit, for example, a multi-port valve. In one aspect of the invention diverter valves 70, 71, 75 and 170 may comprise variable diverter valves that allow the user to vary the volume of diverted flow as desired, for example, from completely diverted to completely undiverted flow. In addition, diverter valves 70, 71, 75 and 170 may divert flow from one conduit to one or more conduits, for example, two or more conduits, whereby water can be diverted to two or more locations in bathing enclosure 42 via two or more conduits 72. In one aspect of the invention, diverter valves 70, 71, 75 and 170 may divert flow away from one or more first water jets 46 while minimizing the variation of fluid pressure upon one or more second water jets 46, for example, while minimizing the variation in pressure in manifold 56. According to this aspect of the invention, the flow of water from one or more water jets 46 may be diverted while having little or no effect upon the flow of water out of other water jets 46.

[0031] FIGURE 3 is a cross-sectional view of one diverter valve 80 according to one aspect of the invention, for example, valve 80 may be used for valve 70, 71, 75 or 170 in FIGURE 2. In one aspect of the invention, valve 80 may be mounted in a wall of enclosure 42, for example, in a wall of foot well 52. Valve 80 includes a hollow cylindrical housing 82, for example, a circular cylindrical housing, having a first end 84 and a second end 86. In one aspect of the invention, first end 84 comprises the outlet of valve 80. According to this aspect of the invention, first end 84 ultimately

communicates with one or more water inlets to a water enclosure, for example, to one or more water inlets 73 into foot well 52 via conduit 72 shown in FIGURE 2.

[0032] Valve 80 also includes an inlet 88, for example, a circular inlet, which communicates with the hollow interior of housing 82. In one aspect of the invention, inlet 82 is in fluid communication with a source of pressurized water (not shown), for example, in fluid communication with the outlet of pump 60 shown in FIGURE 2, whereby pressurized water is introduced to the interior of housing 82 via inlet 88. Valve 80 may also include a barrier 90 positioned between inlet 88 and the second end 86 of housing 82. Barrier 90 substantially hydraulically isolates the first end 84 of housing 82 from the second end 86 of housing 82. Barrier 90 may comprise a plate, for example a flat, circular plate, mounted in housing 82. As shown in FIGURE 3, barrier 90 may also comprise a curvilinear structure, for example, a curvilinear structure that provides a uniform curved flow path from inlet 88 to housing 82. In one aspect of the invention, inlet 88 and barrier 90 may comprise a pipe elbow, for example, either a long- or a short-radiused pipe elbow.

[0033] Valve 80 also includes an orifice assembly 92 mounted in housing 82 and a valve control mechanism 93 attached to orifice assembly 92. Control mechanism 93 may be operated by handle assembly 95. An exploded perspective view of orifice assembly 92 and control mechanism 93 is shown in FIGURE 4. With reference to FIGURE 3, in one aspect of the invention, orifice assembly 92 is mounted between barrier 90 and the first end 84 of housing 82. In one aspect of the invention, orifice assembly 92 may be rigidly mounted in housing 82. In another aspect of the invention, orifice assembly 92 may be slidably mounted in housing 82.

[0034] With reference to FIGURES 3 and 4, orifice assembly 92 includes a hollow valve body 94 and an orifice cover 96. Valve body 94 may be mounted, for example, fixed or slidably mounted, in housing 82, for example, adjacent first end 84 of housing 82. Valve body 94 comprises a hollow cylindrical body, for example, a circular cylindrical body, having an open first end 98 and a generally closed second end 100. As shown in FIGURES 3 and 4, second end 100 of valve body 94 includes at least one

orifice 102, for example, a circular orifice, though, according to one aspect of the invention, any shape of orifice 102 may be used. Though orifice 102 is shown as a cylindrical orifice, according to one aspect of the invention, orifice 102 may be conical, for example, a conically convergent or divergent orifice. Orifice cover 96 is adapted to fit over office 102 to at least partially obstruct orifice 102. In one aspect of the invention, orifice cover 96 is adapted to essentially completely obstruct orifice 102. In one aspect of the invention, orifice cover 96 includes a wider section 104 having a first outer dimension 105, for example, a first outer diameter, and a projection 106 having second outer dimension107, less than the first outer dimension, and projection 106 is adapted to be inserted into orifice 102. A sealing element 97, for example, an annular elastomeric gasket, may be installed between orifice cover 96 and valve body 94 to enhance the sealing of the interface between orifice cover 96 and valve body 94.

[0035] As shown in FIGURE 3, the position of orifice cover 96 may be controlled by valve control mechanism 93. Valve control mechanism 93 may comprise an automated control mechanism, for example, using motors or solenoids, but in one aspect of the invention, valve control mechanism 93 is manually operated by means of handle assembly 95. Handle assembly 95 may be accessible to an occupant of enclosure 42.

[0036] As shown in FIGURES 3 and 4, valve control mechanism 93 may include one or more rods 108 that mechanically couple orifice cover 96 to handle assembly 95. In the aspect of the invention shown in FIGURES 3 and 4, valve control mechanism 93 includes at least one rod 108. Rod 108 is attached to orifice cover 96 and is operatively connected to handle 95. In one aspect of the invention, valve mechanism 93 includes at least one second rod 110. Rod 110 may be operatively connected to rod 108 and to handle assembly 95. Rod 108 may be a threaded rod and rod 108 may be threaded into a threaded hole 109 in orifice cover 96, though other conventional means of attaching rod 108 to orifice cover 96 may be used. Similarly, rod 110 may be a threaded rod and rod 110 may be threaded into a threaded hole in handle assembly 95, though other conventional means of attaching rod 110 to handle assembly 95 may be used. Rod 108 and rod 110 may be mechanically coupled by conventional means, for

example, engaged by screw threads, or rods 108 and 110 may comprise a single rod extending from orifice cover 96 to handle assembly 95. According to the aspect of the invention shown in Figure 3, rod 110 passes through barrier 90, for example, through a hole 91 in barrier 90. In one aspect of the invention, a seal, for example, an O-ring-type seal, may be mounted on either rod 110 or in hole 91 to minimize the leakage of water passed barrier 90. In another aspect of the invention, the clearance between rod 110 and hole 91 may be small enough that no fluid leakage occurs and no seal is necessary.

[0037] In one aspect of the invention, as shown in FIGURE 3, rod 108 may be smaller in diameter than rod 110 and rod 110 may include a recess 111 into which rod 108 extends. In this aspect of the invention, rod 108 includes a threaded end 112 and a nut 114 threaded onto threaded end 112. Recess 111 may be adapted to engage nut 114, for example, recess 111 may have a polygonal geometry, for example, a hexagonal geometry, which engages nut 114 whereby the rotation of rod 110 rotates nut 114 on rod 108. In the aspect shown, valve control mechanism 93 may also include a washer 116 (though in one aspect of the invention, no washer 116 is needed) and a spring 118, for example, a coil spring or a Belleville-type spring washer. Spring 118 may be positioned between washer 116 and nut 114 whereby rotation of nut 114 compresses or releases spring 118. Compression or release of spring 118 compresses or releases, respectively, the load of spring 118 on housing 94, or washer 116, whereby orifice cover 96 is drawn into or extended out of orifice 102.

[0038] According to this aspect of the invention, orifice assembly 92 is exposed to a differential pressure, that is, a pressure difference provided by the pressure provided by pump 60 to inlet 88 and a typically somewhat lower pressure in the first end 84 of housing 82. Since valve body 94 may be fixed, or at least limited in movement, in housing 82, the pressure difference across orifice assembly 92 is typically exerted upon orifice cover 96. This pressure on orifice cover 96 is transmitted via rod 108 to spring 118 via nut 114. Thus, the rotation of nut 114 by handle assembly 95 via rod 110 either compresses or uncompresses spring 118 and increases or decreases the resistance to

deflection of orifice cover 96 by the differential pressure across orifice assembly 92. When nut 114 is rotated by handle assembly 95 whereby spring 118 is compressed, rod 108 via nut 114 increases the resistance to deflection of orifice cover 96, and thus reduces the relative amount of water - at a given pressure - that may pass from inlet 88, through orifice 102, and out of first end 84 of housing 82 and to, for example, water jets 46. Conversely, when nut 114 is rotated whereby spring 118 relieves the compression of spring 118, rod 108 decreases the resistance to deflection of orifice cover 96, and thus increases the amount of water that may pass - at a given pressure - from inlet 88, through orifice 102, and out of first end 84 of housing 82 and to, for example, water jets 46. As a result, the rotation of handle assembly 95 by an occupant of enclosure 42 may regulate the amount of water allowed to pass from the source of pressurized water to the water jets in enclosure 42. Moreover, according to one aspect of the invention, valve 80 permits the regulation of flow out of one or more water jets 46 without undesirably increasing the flow out of one or more other water jets 46.

[0039] Handle assembly 95 may comprise any conventional handle assembly adapted to activate valve control mechanism 93 to regulate the flow out of valve 80. According to one aspect of the invention, shown in FIGURE 3, handle assembly 95 may comprise a retainer 120 and a knob 122 mounted to the retainer 120. In one aspect of the invention, rod 110 includes an annular ring 124 that provides a shoulder on which retainer 120 bears when rod 110 is inserted in retainer 120. In one aspect of the invention, retainer 120 includes a through hole 126 (see FIGURE 4) through which rod 110 extends to engage knob 122. Rod 110 may also include an extension 128 that passes through through-hole 126 and engages knob 122. In one aspect of the invention, extension 128 is non-circular in cross-section, for example, as shown in FIGURE 4, extension 128 may be polygonal, for example, square, in cross-section. In one aspect of the invention, through hole 126 in retainer 120 may include an annular recess 121 for a sealing element 123, for example, an o-ring-type seal, to minimize or prevent leakage through hole 126. A sealing element 135, for example, an o-ring-type seal or a gasket-type seal, may be inserted between retainer 120 and the second end 86 of housing 82.

[0040] Knob 122 of handle assembly 95 may comprises any conventional structure which is adapted to manually turned by an occupant of enclosure 42. Knob 122 may be circular or non-circular. Knob 122 may include a projection 131 which extends diametrically across knob 122 which can more readily engaged by the occupant of enclosure 42. Handle assembly 95 may be connected to rod 110 by one or more threaded bolts or screws 125. For example, rod 110 may have an internally threaded hole 129 to accept bolt or screw 125. Knob 122 may include a recess 127 having a through hole through which screw 125 may be inserted to engage hole 129.

[0041] Housing 82 of valve 80 may be mounted wherever convenient, for example, in, around, or on enclosure 42. In one aspect of the invention, valve 80 is mounted to a wall of enclosure 42, for example, a horizontal, vertical, or inclined wall of enclosure 42. In one aspect of the invention, as shown in FIGURE 3, valve 80 may be mounted to a sidewall of foot well 52. Valve 80 may be mounted to any sidewall of enclosure 42 by any conventional means, for example, by means of mechanical fasteners or adhesives.

[0042] In one aspect of the invention, as shown in FIGURE 3, valve 80 may be mounted adjacent to seat 48 (see FIGURE 2) to be readily accessible to a bather sitting in or near seat 48, for example, mounted to a wall of foot well 52 by means of a threaded pipe flange 130. In one aspect of the invention, the threaded pipe flange 130 may be mounted to housing 82 of valve 80, for example, threadably mounted, or mounted by mechanical fasteners, adhesives, or welding, among others means. In one aspect of the invention, pipe flange 130 may be integral with housing 82, for example, pipe flange 130 may comprise the second end 86 of housing 82, for example, the as-molded end of housing 82. Pipe flange 130 may have an externally threaded cylindrical section 132 having external threads 134. According to this aspect of the invention, valve 80 may be mounted in an opening 136 in the wall of foot well 52 and secured to the wall of foot well 52 by a one or more threaded collars 138 having internal threads 140 which engage external threads 134 of cylindrical section 132 of threaded pipe flange 130. A gasket 142, for example, an annular gasket, may be inserted between threaded pipe flange 130 and the wall of foot well 52 to minimize leakage.

[0043] The components of valve 80, for example, housing 82, valve body 94, orifice cover 96, barrier 90, handle assembly 95, pipe flange 130 and retainer 138, among other items of the present invention, may be fabricated from any convenient metallic material, for example, stainless steel or aluminum, or non-metallic material, for example, wood, rubber, or plastic. However, since the components of valve 80 may typically be exposed to the aqueous chemical environment of a pool or spa, for example, a chlorine-containing environment, in one aspect of the present invention, the components of valve 80 may be fabricated from chemical resistant and corrosion resistant materials, such as plastics. In one aspect of the invention, the materials of construction are readily fabricated to provide the desired shape and construction, for example, are readily molded or fabricated from stock material shapes. In one aspect of the invention, one or more components of valve 80 may be fabricated from polyvinyl chlorine (PVC) plastics, chlorinated polyvinyl chloride (CPVC) plastics, polyethylene (PE), polypropylene, acrylonitrile-butadiene-styrene (ABS), nylon, polytetraflouroethylene (PTFE), or their equivalents.

[0044] Aspects of the present invention provide systems, methods, and valves for providing pressurized water to a plurality of water inlets in a bathing enclosure. Aspects of the invention overcome the limitations of the prior art by allowing the bather to regulate the flow of pressurized water to one or more water jets without affecting the flow of water to other water jets. As will be appreciated by those skilled in the art, features, characteristics, and/or advantages of the systems, methods, and valves described herein, may be applied and/or extended to any embodiment (e.g., and/or portion thereof).

[0045] Although several aspects of the present invention have been depicted and described in detail herein, it will be apparent to those skilled in the relevant art that various modifications, additions, substitutions, and the like can be made without departing from the spirit of the invention and these are therefore considered to be within the scope of the invention as defined in the following claims.

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